

What is claimed is:

1 ~~1.~~ A method for communicating multicast group membership
 2 information in a network between a plurality of routers in a multicast group,
 3 wherein each of the plurality of routers reports routing tree information to other
 4 routers of said plurality of routers, said method comprising the steps of:

5 receiving update information at a second router in the network,
 6 said update information transmit from a first router and including
 7 update information on a multicast group;

8 determining, based at least in part on said update information and
 9 the routing tree information reported by said first router, whether
 10 said second router must transmit said update information to at
 11 least one neighbor router of said second router so that all
 12 members of said multicast group remain connected; and

13 in response to a positive determination:

14 transmitting said update information from said second router to
 15 said at least one neighbor router of said second router.

1 2. The method of claim 1, wherein said update information includes
 2 an identifier of said multicast group.

1 3. The method of claim 1, wherein said update information includes
 2 a network address of said first router.

1 4. The method of claim 1, wherein said update information includes
 2 an indication that said first router is becoming a member of said multicast
 3 group.

1 5. The method of claim 4, wherein the routing tree information
 2 comprises a source tree for a unicast routing protocol, and wherein said step
 3 of determining comprises determining if said source tree reported by said first
 4 router has said second router as the root of a subtree from which said first

5 router is excluded, and if at least one neighbor router of said second router in
6 said subtree is not a member of said multicast group.

1 6. The method of claim 5, wherein said step of determining further
2 comprises determining if said first router is not a member of said multicast
3 group.

1 7. The method of claim 6, wherein said update information includes
2 a time stamp, and wherein said step of determining further comprises
3 determining if said time stamp is valid.

1 8. The method of claim 7, wherein said time stamp comprises a first
2 time stamp and wherein said step of determining if said time stamp is valid
3 comprises determining if said first time stamp is more recent than a second
4 time stamp stored in said second router, wherein said second time stamp is
5 associated with said multicast group and said first router.

1 9. The method of claim 1, wherein said update information includes
2 an indication that said first router is no longer a member of said multicast
3 group.

1 10. The method of claim 9, wherein the routing tree information
2 comprises a source tree for a unicast routing protocol, and wherein said step
3 of determining comprises determining if said source tree reported by said first
4 router has said second router as the root of a subtree from which said first
5 router is excluded, and if at least one neighbor router of said second router in
6 said subtree is a member of said multicast group.

1 11. The method of claim 10, wherein said step of determining further
2 comprises determining if said first router is not a member of said multicast
3 group.

1 12. The method of claim 11, wherein said update information includes
2 a time stamp, and wherein said step of determining further comprises
3 determining if said time stamp is valid.

1 13. The method of claim 12, wherein said time stamp comprises a first
2 time stamp and wherein said step of determining if said time stamp is valid
3 comprises determining if said first time stamp is more recent than a second
4 time stamp stored in said second router, wherein said second time stamp is
5 associated with said multicast group and said first router.

1 14. A method for forwarding multicast packets in a network
2 comprising a plurality of routers in a multicast group, wherein each of the
3 plurality of routers reports routing tree information to other routers of said
4 plurality of routers, said method comprising the steps of:
5 receiving a multicast packet at a second router, said multicast
6 packet transmit from a first router and including control
7 information;
8 determining, based at least in part on said control information and
9 the routing tree information reported by said first router, if said
10 multicast packet is to be forwarded by said second router; and
11 in response to a positive determination that said multicast packet
12 is to be forwarded in said step of determining:
13 forwarding said multicast packet from said second router to at
14 least a third router.

1 15. The method of claim 14, wherein said multicast packet includes
2 an address of the multicast group.

1 16. The method of claim 14, wherein said multicast packet includes
2 an address of the source of said multicast packet.

1 17. The method of claim 14, wherein said multicast packet includes a
2 time value, wherein said time value is used to limit the time said multicast
3 packet is allowed to remain in the network.

1 18. The method of claim 14, wherein said second router maintains a
2 multicast forwarding cache, and said multicast forwarding cache includes an

3 entry indicating that a multicast packet from a selected source and a selected
 4 multicast group should be forwarded from said second router, and wherein
 5 said method further comprises creating said entry after making a positive
 6 determination that said multicast packet is to be forwarded, if said multicast
 7 packet is from said selected source and for said selected multicast group.

1 19. The method of claim 14, wherein said second router maintains a
 2 multicast packet-forwarding cache, and wherein said multicast packet-
 3 forwarding cache includes an entry indicating each multicast packet recently
 4 forwarded by said second router.

1 20. The method of claim 14, wherein the routing tree information
 2 reported by said first router comprises a source tree for a unicast routing
 3 protocol, and wherein said step of determining comprises determining if said
 4 first router is the next hop in the shortest path from said second router to the
 5 source of the multicast packet according to said source tree, and if said
 6 source tree has said second router in a subtree with at least one router in said
 7 subtree being a member of the multicast group.

1 ~~21.~~ An apparatus for communicating multicast group membership
 2 information in a network between a plurality of routers in a multicast group,
 3 wherein each of the plurality of routers reports routing tree information to other
 4 routers of said plurality of routers, said apparatus comprising:

5 a first router, said first router for receiving update information
 6 transmit from a second router and including update information on
 7 a multicast group, wherein said first router determines, based at
 8 least in part on said update information and the routing tree
 9 information reported by said second router, whether said first
 10 router must transmit said update information to at least one
 11 neighbor router of said first router so that all members of said
 12 multicast group remain connected, and wherein said first router,
 13 in response to a positive determination that said first router must

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transmit said update information, transmits said update
information to said at least one neighbor router.

1 22. The apparatus of claim 21, wherein said update information
2 includes an identifier of said multicast group.

1 23. The apparatus of claim 21, wherein said update information
2 includes a network address of said first router.

1 24. The apparatus of claim 21, wherein said update information
2 includes an indication that said second router is becoming a member of said
3 multicast group.

1 25. The apparatus of claim 24, wherein the routing tree information
2 comprises a source tree for a unicast routing protocol, and wherein said first
3 router determines whether said first router must transmit said update
4 information by determining if said source tree reported by said second router
5 has said first router as the root of a subtree from which said second router is
6 excluded, and at least one neighbor router of said first router in said subtree is
7 not a member of said multicast group.

1 26. The apparatus of claim 25, wherein said first router further
determines whether said first router must transmit said update information by
3 determining if said second router is not a member of said multicast group.

1 27. The apparatus of claim 26, wherein said update information
2 includes a time stamp, and wherein said first router further determines
3 whether said first router must transmit said update information by determining
4 if said time stamp is valid.

1 28. The apparatus of claim 27, wherein said first router further stores
2 a time stamp associated with said multicast group and said second router,
3 wherein said time stamp comprises a first time stamp and wherein said first
4 router determines whether said time stamp is valid by determining if said first
5 time stamp is more recent than said second time stamp.

1 29. The apparatus of claim 21, wherein said update information
2 includes an indication that said second router is no longer a member of said
3 multicast group.

1 30. The apparatus of claim 29, wherein the routing tree information
2 comprises a source tree for a unicast routing protocol, and wherein said first
3 router determines whether said first router must transmit said update
4 information by determining if said source tree reported by said second router
5 has said first router as the root of a subtree from which said second router is
6 excluded, and at least one neighbor router of said first router in said subtree is
7 a member of said multicast group.

1 31. The apparatus of claim 30, wherein said first router further
2 determines whether said first router must transmit said update information by
3 determining if said second router is not a member of said multicast group.

1 32. The apparatus of claim 31, wherein said update information
2 includes a time stamp, and wherein said first router further determines
3 whether said first router must transmit said update information by determining
4 if said time stamp is valid.

1 33. The apparatus of claim 32, wherein said first router further stores
2 a time stamp associated with said multicast group and said second router,
3 wherein said time stamp comprises a first time stamp and wherein said first
4 router determines whether said time stamp is valid by determining if said first
5 time stamp is more recent than said second time stamp.

1 ~~34.~~ An apparatus for forwarding multicast packets in a network
2 comprising a plurality of routers in a multicast group, wherein each of the
3 plurality of routers reports routing tree information to other routers of said
4 plurality of routers, said apparatus comprising:

5 a first router, said first router for receiving a multicast packet from
6 a second router in a network determining, based at least in part,
7 on said control information and the routing tree information

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reported by said second router, if said multicast packet is to be forwarded by said first router, and wherein said first router, in response to a positive determination that said multicast packet is to be forwarded, forwards said multicast packet to at least a third router

1 35. The apparatus of claim 34, wherein said multicast packet includes
2 an address of the multicast group.

1 36. The apparatus of claim 34, wherein said multicast packet includes
2 an address of the source of said multicast packet.

1 37. The apparatus of claim 34, wherein said multicast packet includes
2 a time value, wherein said time value is used to limit the time said multicast
3 packet is allowed to remain in the system.

1 38. The apparatus of claim 34, wherein said first router further
2 includes a multicast forwarding cache, wherein said multicast forwarding
3 cache includes an entry indicating that a multicast packet from a selected
4 source and a selected multicast group should be forwarded from said first
5 router and wherein said first router creates said entry after making a positive
6 determination that said multicast packet is to be forwarded, if said multicast
7 packet is from said selected source and for said selected multicast group.

1 39. The apparatus of claim 34, wherein said first router comprises a
2 multicast packet-forwarding cache, and wherein said multicast packets
3 forwarding cache includes an entry indicating each multicast packet recently
4 forwarded by said first router.

1 40. The apparatus of claim 34, wherein the routing tree information
2 reported by said second router comprises a source tree for a unicast routing
3 protocol, and wherein said step of determining comprises determining if said
4 second router is the next hop in the shortest path from said first router to the
5 source of the multicast packet according to said source tree, and if said

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- 6 source tree has said first router in a subtree with at least one router in said
 - 7 subtree being a member of the multicast group.
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